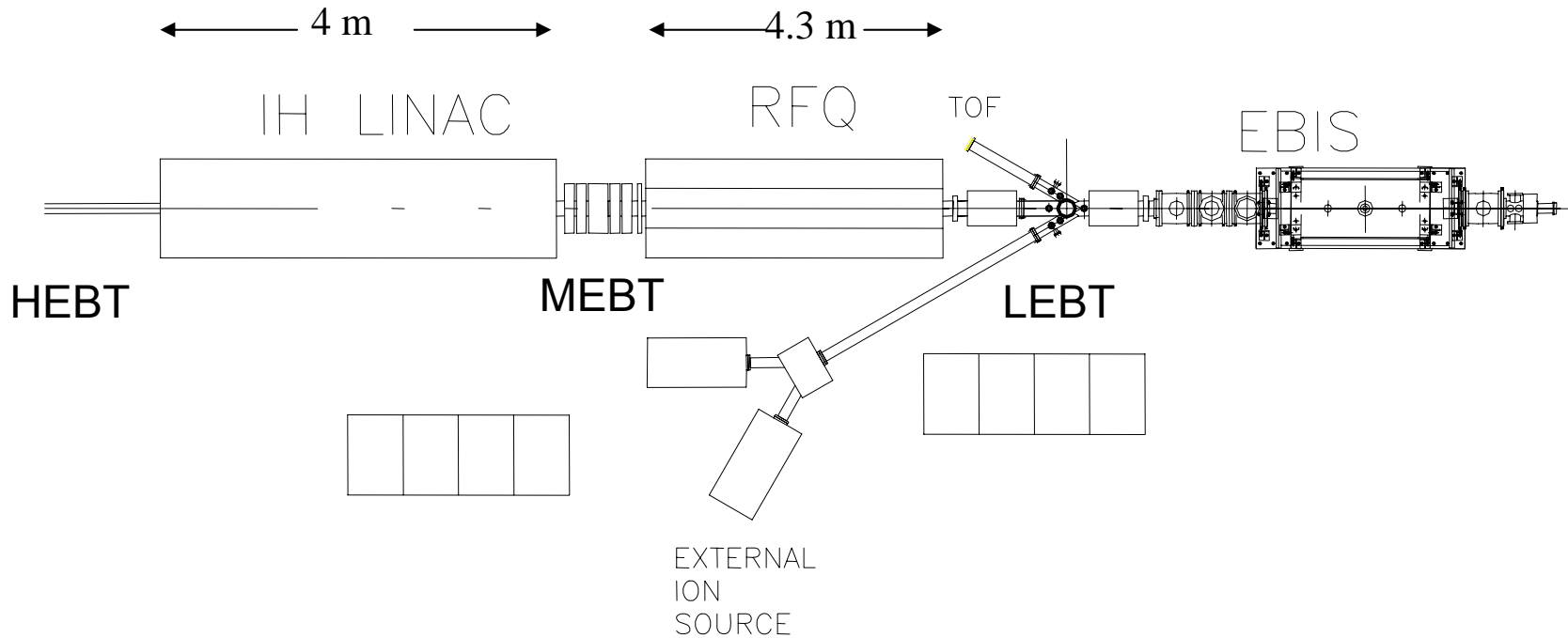


WBS 1.1 Structural Components RFQ, Linac, & Bunchers

Jim Alessi

July 25-27, 2005

Preinjector Layout



RFQ: 17 - 300 keV/u; 100 MHz

IH Linac: 0.3 - 2.0 MeV/u; 100 MHz

RFQ (vs. CERN Pb RFQ)

Parameters	BNL	CERN	Units
Type	4-rod	4-rod	
Q/m	0.16-0.5	0.12	
Input Energy	16.2	2.5	keV/amu
Output Energy	314.72	250	keV/amu
Frequency	101.28	101.28	MHz
Max rep rate	10	10	Hz
Length	4.37	2.5	meters
Number of cells	277		
Aperture Radius	0.005	.0045	meters
Voltage	69	70	kV
E(surface)	20.8	≤ 23	MV/m
RF Power	< 350	< 350	kW
Acceptance	1.7	> 0.8	π mm mrad (nor)
Input Emittance	0.35		π mm mrad, nor, 90%
Output Emittance (trans)	0.375		π mm mrad, nor, 90%
Output Emittance (longit)	33.6		π MeV deg, 90%
Transmission	91	93	%
Bravery factor	1.8	≤ 2	Kilpatrick

IH Linac (vs. CERN Pb IH)

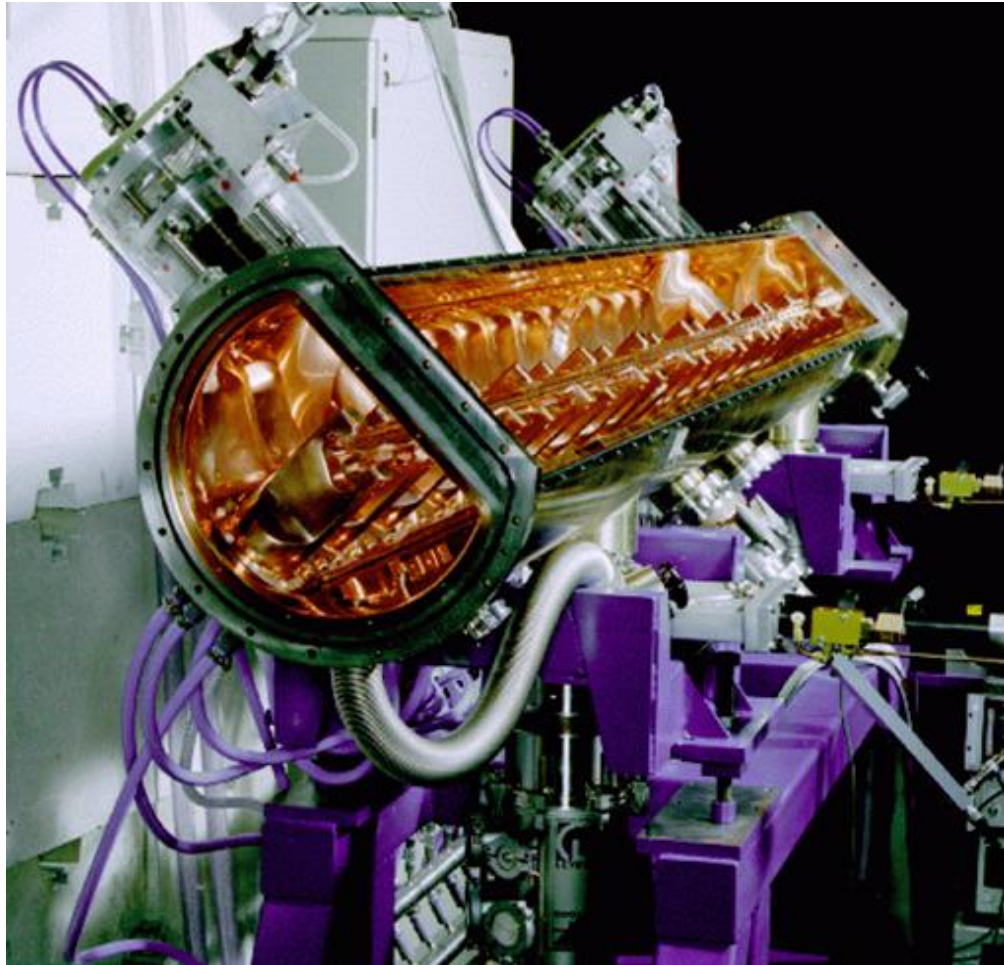
Parameters	BNL	CERN Tank 1	Units
Q/m	0.16-0.5	0.12	
Input energy	0.314	0.250	MeV/amu
Output Energy	2.08	1.87	MeV/amu
Frequency	101.28	101.28	MHz
Max rep rate	5	10	Hz
Length	4.0	3.57	Meters
Input emittance	0.55		π mm mrad, norm, 90%
Output emittance	0.61		π mm mrad, norm, 90%
Output energy spread	20.0		keV/amu
Transmission	100		%

Two quadrupole triplets inside for focusing.

The maximum field on the axis will be 13.5 MV/m.

Fixed output velocity, independent of the q/m of the desired beam (cavity gradient is adjusted for different q/m's, to maintain a fixed velocity profile).

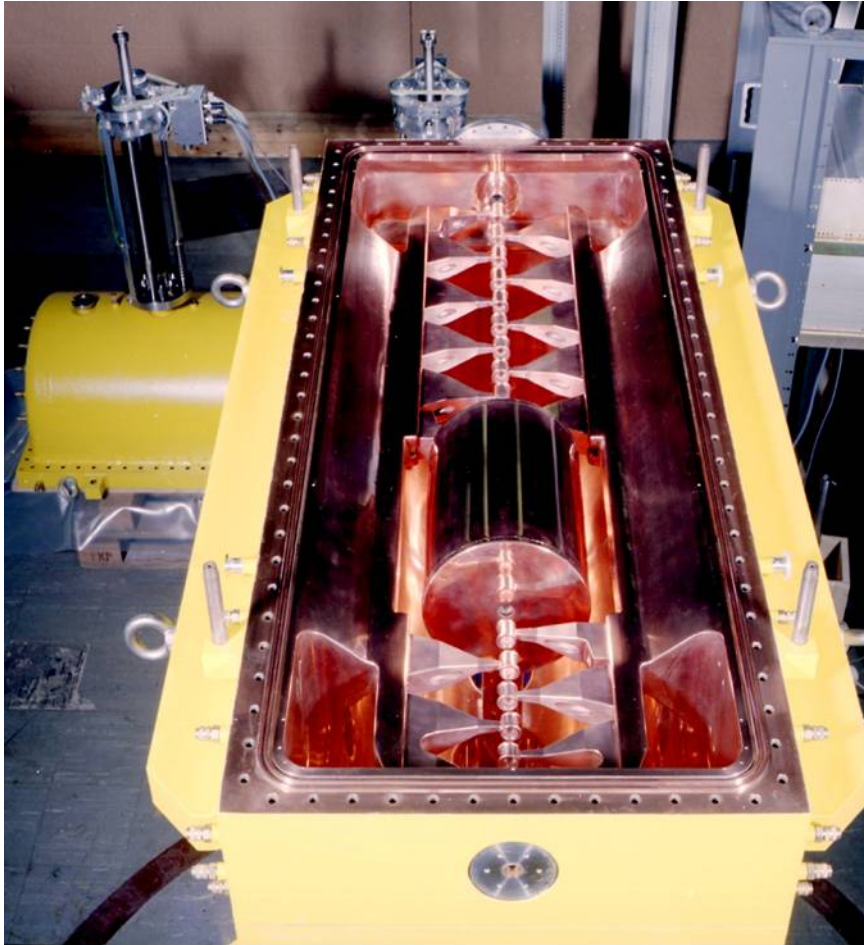
REX-Isolde RFQ



5 keV/u to 300 keV/u
101.28 MHz
 $Q/m = 1/4.5$ (1/6.5 possible)
 $L = 3\text{m}$
 $R_s = 146\text{ k}\Omega/\text{m}$
 $P = 30\text{ kW}$
 $Q = 4050$

~GSI HLI-Linac and
Heidelberg high-current
injector

REX-Isolde IH Linac



0.3 MeV/u to 1.2 MeV/u

101.28 MHz

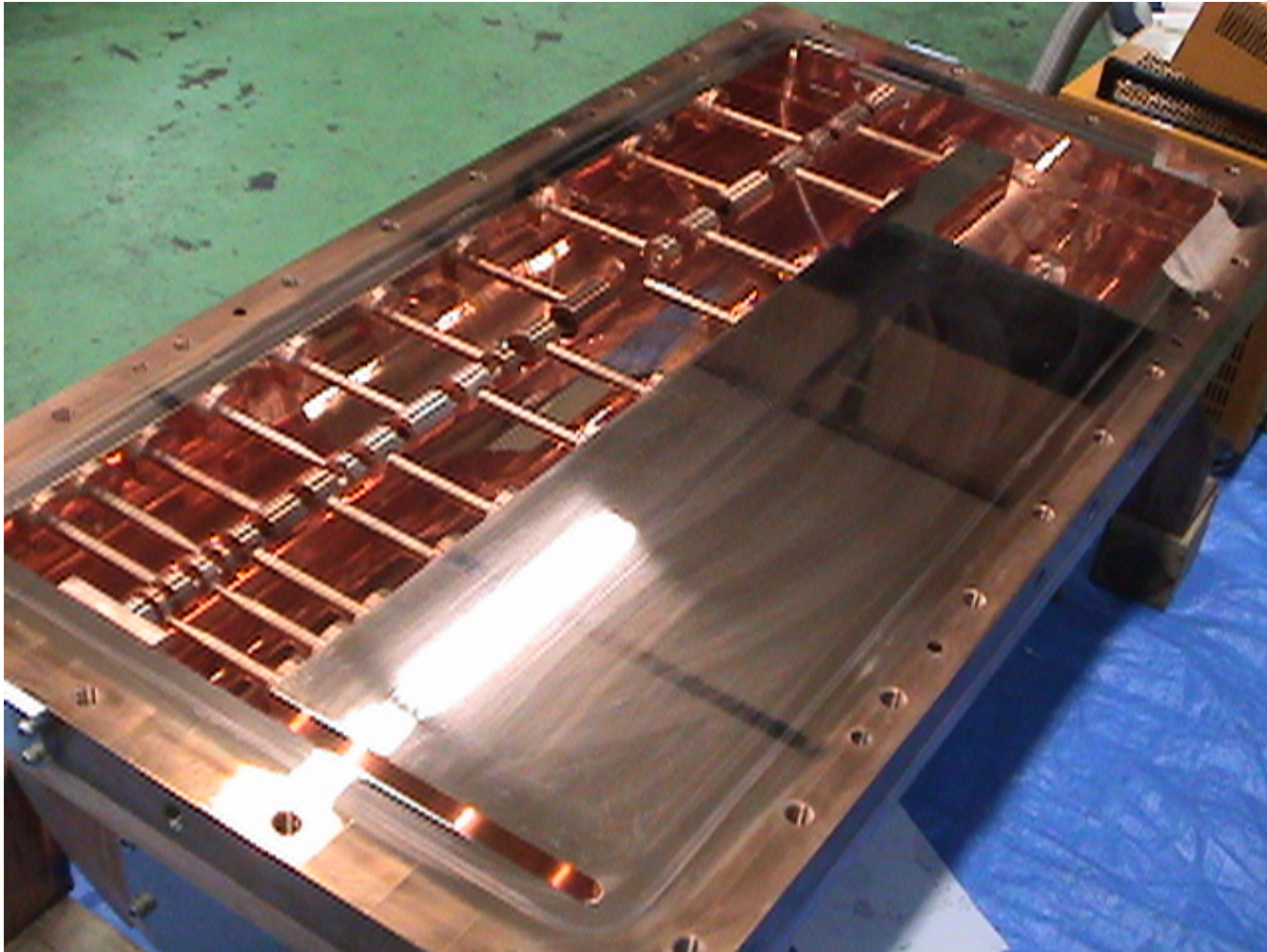
$L=1.5$ m

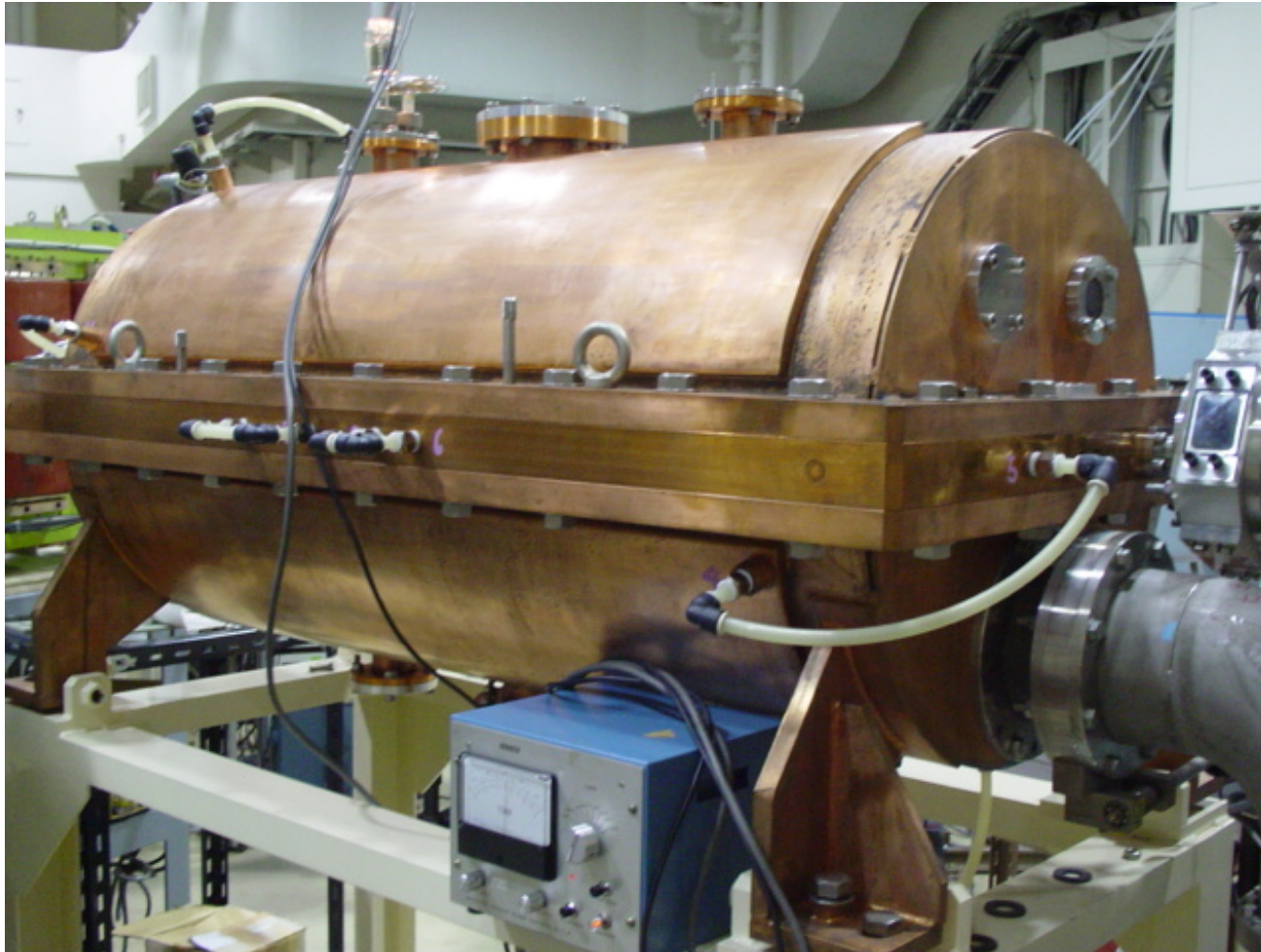
$Q/m=1/4.5$

$R_s=330$ M Ω /m

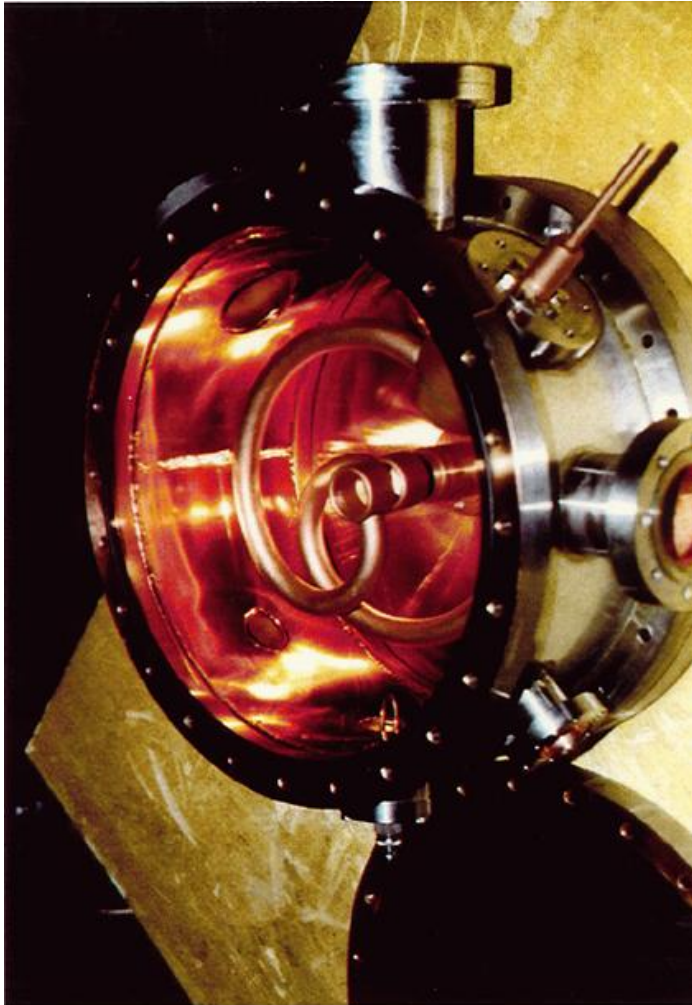
$P=65$ kW

~GSI HLI-IH and CERN Tank1





REX-Isolde Bunchers (split-ring)



$Q/m=1/4.5$

101.28 MHz

$L=0.2$ m, 3 gaps (70 kV integrated)

$P=2$ kW

~GSI HLI and CERN Pb linac

Procurement of the following devices:

RFQ:

100 MHz, 4 rod design is conventional. Very similar to GSI, CERN, etc.
Will buy RFQ from Frankfurt.

LINAC:

IH structure chosen, very similar to CERN Pb linac. (conventional baseline design).

Will probably get IH from GSI / Frankfurt.

Will still investigate alternatives (electrostatic focusing) in FY'06.

Bunchers – 1 in MEBT, 2 in HEBT (Frankfurt)

Discussions and correspondence with Frankfurt (Schempp, Ratzinger) – they are ready to build the RFQ and Linac for the project.

RFQs and Bunchers supplied by Schempp

11.7.05

Projects : RFQs built for other Institutions

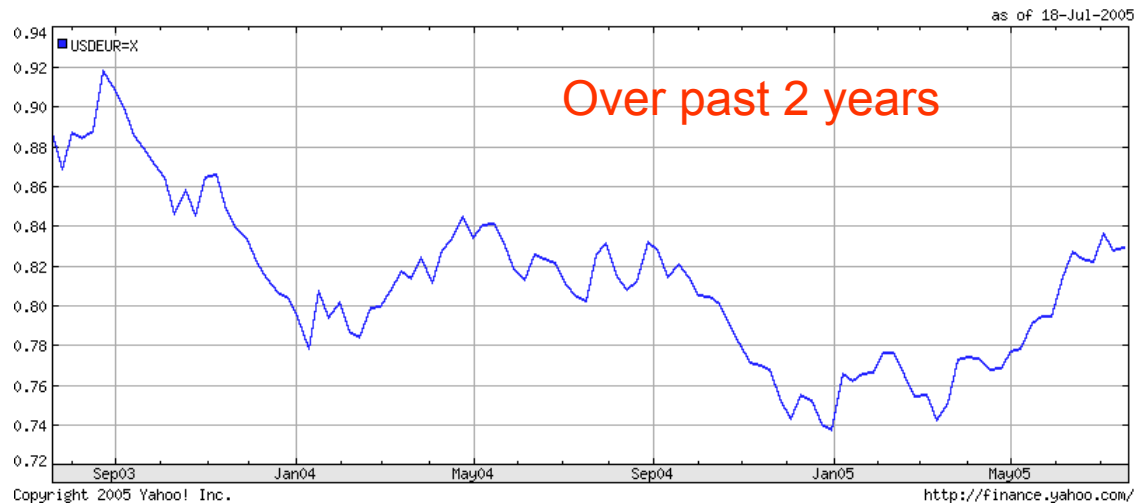
GSI: HLI RFQ	EZR	25% df,
HSI *	MeVVa, Cordis	
SCR	He+	
Spiral	Cordis	27MHz U 2+
ESS-prototype	Duopl. p	
DESY 750keV inj.I	Magnetron	18keV Inj. 25 mA
DESY 750keV inj.II	Bucket	35keV 50mA
RAL I,II	Penning	5%df 35mA ISIS injector
MSI Stockholm	EBIS	
Saclay	EBIS	
Lyon	Cluster m=50	
Lyon	Cluster m=1000	
CERN /Orsay	p-bar Lear	Decelerator
MPI Heidelberg I,II*	EZR, Cordis	
LMU München/Rex-Isolde*	EZR, Isol	
HMI-Berlin I,II	EZR	cw-cyclotron injector
DeBTec	volume p,D	20%df
Prema I,II,III*	P++, EZR	HE-Implanters
Med-HD	EZR p-C	Med.Therapy acc.
GSI/Heidelberg		
IKF	EZR	
Riken	Laser-IS	60mA C4+

*=collaboration

Besides RFQs, there were appr. 20 Buncher, Rebuncher, Post acc Cavities “exported”
CERN 4, GSI 6, Desy 3, Rex 1, SA 1, MSI, Sacl,Pr. 3,IKF 2 resonators,,

WBS 1.1 Structural Components

- Major procurements (direct costs, '05\$):
 - RFQ: 340 k\$; 30% contingency
 - Linac: 400 k\$; 40% contingency
 - Bunchers: 3 @ 33 k\$; 30% contingency
- Risks
 - Technical risk is low
 - Schedule risk – both are on critical path for the project
 - Cost risk – \$/Euro



**RFQ procurement early in FY'06 with NASA \$
~ 18 month delivery; test ~ Q3/4 of FY'07 (on Test
EBIS)**

**Linac procurement in FY'07; install in Q4, FY'08.
(gives ~ 1 year to investigate alternative linac
options)**

WBS 1.1 Structural Components

- Estimated Cost

WBS	Description	Direct FY'05K\$			
		Mat'l	Labor	Contingency	Total
1.1	Structural Components	1675	680	\$665 (28%)	3020
	EBIS, LEBT, external inj	770	480	\$320 (26%)	1570
	RFQ, Linac, Bunchers	905	200	\$345 (31%)	1450

- Labor hours/equivalents

	RFQ, Linac, Bunchers
Resource Category	estimated hours
Scientist	865
Engineer	920
Designer	120
Technician	860
Management	0
Building Trades	0
Total	2765
Full Time Equivalents	1.6